80

"Ramon Ricondo" <r_ricondo@ricondo.com>

09/27/2005 03:08 PM

To Dennis Walsh/AWA/FAA@FAA, Richard Kula/AGL/FAA@FAA

cc "Shawn Kinder" <s_kinder@ricondo.com>, "Carmela Rubin" <c_rubin@ricondo.com>

bcc

Subject RE: 2004 TAF for BCA purposes

History: This message has been forwarded.

Hi Dennis, Rich,

Attached please find a draft of the revised Supplemental BCA. Both a pdf and a Word file are included. Please distribute this to others at FAA as appropriate.

Dennis, I left you a message but obviously was not able to speak with you directly, though I did discuss a couple of changes with Rich and with Frank Berardino. Those changes relate to 1) a couple of sentences that we deleted in the last paragraph of the document FAA provided regarding the 2004 TAF's (shown as Appendix E), and 2) the language in section 5.2.5.2 referencing the February 2005 BCA which we left in the document. Please feel free to give me a call if you want to discuss the rationale for these two suggested changes.

Please let us know if you have any further revisions or if you would like us to coordinate with the City for a formal submittal of a final document.

If you need to get a hold of me later today, please feel free to contact me on my cell phone at 312-656-1947.

Ramon

-----Original Message-----
From: Shawn Kinder
Sent: Friday, September 23, 2005 2:40 PM
To: dennis.walsh@faa.gov
Cc: Ramon Ricondo
Subject: RE: 2004 TAF for BCA purposes

We'll think through this as we are revising the document.

We are shooting for another submittal by the end of Monday.

I will likely be tied up most of Monday, so please feel free to contact Ramon if you are unable to reach me (also, please copy him on anything you send me on Monday so there is not a delay in us getting back to you). He will be in our downtown office at 312.606.0611 or at rricondo@ricondo.com

Have a great weekend.

Shawn M. Kinder
Ricondo & Associates, Inc. - Chicago
Downtown Office:
Phone: 312.606.0611; Facsimile: 312.606.0706
O'Hare Modernization Program Office:
Phone: 773.557.4869; Facsimile: 773.557.4988
Mobile Phone: 312.890.5222

-----Original Message-----
From: dennis.walsh@faa.gov [mailto:dennis.walsh@faa.gov]
Sent: Friday, September 23, 2005 2:32 PM
To: Shawn Kinder
Subject: 2004 TAF for BCA purposes

shawn
got your voice mail message. good catch.

we may want to revise to include some language regarding the difficulty
of
using TAAM results based on 2002 TAF with 2004 TAF for the purpose of
limiting the use of the 2004 data in the sensitivity analysis. if you
have
some other suggestions, please let me know. otherwise, we'll get back
with you
thanks

Dennis Walsh
APP-510, Financial Analysis and PFC Branch
202-493-4890

BCA Supplemental 9-27.zip

Summary

In February 2005, the City of Chicago (City) submitted a revised request for a Letter of Intent (LOI) for a multiyear commitment of Airport Improvement Program (AIP) funding for Phase 1 of the O'Hare Modernization Program (OMP). That submittal included a Benefit/Cost Analysis (BCA) based primarily on the delay reduction (measured in terms of changes in total aircraft travel time) benefits anticipated to be produced by the project. The February 2005 BCA relied on an assumption that the Base Case and the OMP Scenarios (Scenario Cases) would realize the Environmental Impact Statement (EIS) constrained forecast's level of operations. The Federal Aviation Administration (FAA) subsequently requested that the City provide a supplemental BCA that relaxed the assumption that aircraft operations in the Scenario Cases were capped consistent with the Base Case. This document outlines the methodology, assumptions, and results of that supplemental analysis.

In this analysis, the capacity benefits of the project, i.e. the airport's ability to process additional traffic and passengers as a result of the proposed project, are estimated using consumer surplus as the appropriate measure of the benefits of the project. Consumer surplus is defined as the difference between what consumers must pay for a given level of service and what they would be willing to pay for that same level of service. The FAA provided a document (included in Appendix C) that describes how the benefits of a capacity expansion project can be calculated based on an economic model that measures changes in consumer surplus. This methodology is derived from the information contained in Appendix C, Section C.2 of the *FAA Airport Benefit-Cost Analysis Guidance, December 15, 1999* (*BCA Guidance*).

In the original BCA prepared by the City, benefit-cost ratios were estimated for the *OMP Phase I Airfield* (which consists of the OMP projects for which the LOI monies are being requested and includes the airfield components for which the City has received Majority-In-Interest approval from the airlines and the supporting Program-wide requirements such as preliminary engineering, wetlands mitigation, OMP Phase 1 noise mitigation, land acquisition, and other miscellaneous program-wide requirements) using the base assumptions as well as various sensitivity assumptions. In addition, Appendix D of that document included BCRs for the *Master Plan Phase I* (which included the costs of all projects covered under Phase 1 as defined in the Master Plan Study and EIS, including but not limited to the costs of the Western Concourse, Concourse K extension, Taxiway LL, etc.), the *OMP Total Airfield* (which included the costs of all airfield components of the OMP but did not include terminal and other facility development), and the *Total Master Plan* (which included the costs of all capital projects described in the Airport's Master Plan). This supplemental analysis uses the same project groupings and focuses on the two Phase 1 definitions: *OMP Phase I Airfield* and *Master Plan Phase I*. These two scenarios differ in their cost data; however, for the purposes of this analysis, their benefit streams are identical. As in the previous analyses, 2001 is assumed to be the base year for the analysis, and all dollar values are presented in 2001 dollars.

The City has reviewed the methodology provided by FAA and determined that it is consistent with the FAA's *BCA Guidance*. While the City's February 2005 BCA provided a worst-case scenario of the estimation of project benefits by focusing only on aircraft travel time savings resulting from implementation of the OMP, the methodology provided by FAA for this supplemental analysis provides a mechanism to quantify the benefits associated with the increased traffic and passengers that can be processed by the airport as a result of the capacity increase attributed to the project. This methodology utilizes sound, common economic principles in analyzing the benefits of the program. It relies on the principle that consumers make travel decisions based on the value they receive for the

price they are expected to pay. The following is a summary of the results of the application of this supplemental methodology. Results of sensitivity analyses are discussed in Section V.

Table 1

Summary of Results from Benefit Cost Analyses

Scenario	Present Value Benefits (billions)	Present Value Costs (billions)	Net Present Value (billions)	Benefit-Cost Ratio
OMP Phase 1 Airfield	$12.4	$1.9	$10.4	6.3
Master Plan Phase I	$12.4	$2.7	$ 9.7	4.6

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

New runways at the World's Busiest Airport are necessary. The State of Illinois legislature[1], the Administrator of the FAA[2], and the FAA's EIS all agree on this point. The information contained in this supplemental BCA further substantiates that new runways are worthwhile investments. Consumers will receive more value from a modernized O'Hare than they will from the existing O'Hare; the supplemental BCA supports this conclusion.

The methodology utilized in this supplemental analysis provides for an estimation of project benefits at O'Hare. It does not account for the downstream benefits nor the additional system benefits, expected to be significant, that would also be realized should the project be implemented. For instance, reducing delays at O'Hare would provide benefits to other airports in the national aviation system because O'Hare is a hub for two major airlines. It is well documented that delays at O'Hare have repercussions throughout the country. Likewise, benefits of modernizing O'Hare would "ripple" throughout the system. These additional benefits are not accounted for in this supplemental analysis. Should they be accounted for, the BCA ratios would be even larger than those measured herein.

The costs associated with the OMP have been reviewed by the FAA and their Third Party Consultant as part of the EIS process. They have found these costs to be reasonable, and documentation of this finding is contained in Appendix B of this document.

[1] O'Hare Modernization Act, Illinois Public Act 93-0450, 6 August 2003.
[2] Marion C. Blakey, FAA Administrator, 4 August 2004.

1. Supplemental BCA Methodology

The following assumptions and methodology used to prepare the BCA are in accordance with the FAA's *Benefit-Cost Analysis Guidance* dated December 15, 1999 (the *BCA Guidance*) and the *FAA-APO-03-1, Treatment of Values of Passenger Time in Economic Analysis,* dated March 2003. The methodology for the BCA process is outlined in the *BCA Guidance*. The following generally describes the steps in preparing this BCA:

- *Establish the Objectives:* As stated in the EIS, the proposed Federal action, which is the subject of the EIS, encompasses the following purposes:
  - Address the projected needs of the Chicago region by reducing delays at O'Hare, and thereby enhancing capacity of the NAS.
  - Ensure that existing and future terminal facilities and supporting infrastructure (e.g., access, landside, and related ancillary facilities) can efficiently accommodate airport users.
- *Formulate Assumptions:* Assumptions about future conditions at the airport being analyzed must be clearly explained and documented because they form the framework against which the alternatives are to be evaluated.

  The FAA, as part of the EIS analysis for O'Hare, defined a constrained forecast of activity that would be anticipated to occur without airfield development at the Airport. The 2002 Terminal Area Forecast (TAF), the most recent demand forecast available when the EIS analysis began, was used for the unconstrained scenarios in the EIS. For the purposes of this supplemental analysis, it is assumed that demand would be constrained following the implementation of Phase 1 if the OMP were not completed, and the FAA has developed a constrained forecast of activity for this situation.
- *Identify the Base Case:* The Base Case is a reference point from which incremental benefits and costs can be quantified. In the absence of major airfield construction (such as the OMP), opportunities to increase airfield capacity at the Airport are limited. As such, the Base Case for this BCA is defined as the no action scenario. The Airport's ongoing Capital Improvement Program (CIP), which would occur regardless of the proposed LOI Projects' implementation, is included in the Base Case.
- *Identify and Screen Alternatives:* The FAA has identified and screened alternatives as part of the EIS process. The EIS documents this screening process and identifies the OMP as the preferred alternative. The City of Chicago also believes this is the most effective solution to O'Hare's problems; and, thus, this BCA is based on the OMP.
- *Define Evaluation Period:* Consistent with the *BCA Guidance*, the evaluation period assumed for this BCA extends from the start of construction to 20 years after the completion of construction. For the OMP Phase I Airfield, the evaluation period ends in 2028.
- *Determine Costs:* Costs must be identified, quantified, and evaluated in total dollar amounts and for each year of a project's life. Typical costs include initial investments, such as planning and construction of the main project as well as any enabling projects, and recurring investments, such as operation and maintenance (O&M) costs. OMP costs are discussed in Appendix B of this document.

- *Determine Benefits:* Typical benefits include reduced delays, the ability to accommodate more efficient aircraft and/or larger aircraft, safer and more secure air travel, and reduced environmental impacts.

1.1 Process for Estimating Benefits According to Consumer Surplus

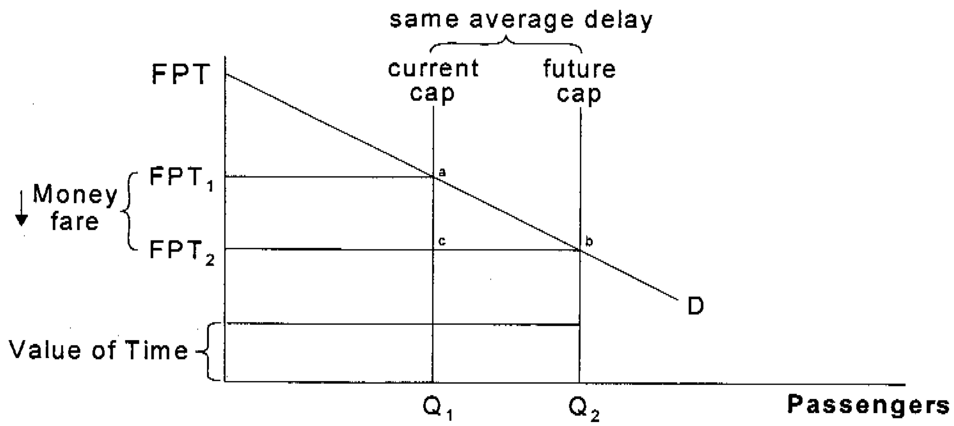
In the present analysis, benefits have been estimated using an economic framework suggested in the *BCA Guidance*, as reported in Appendix C of this document. Benefits were estimated using the economic concept of consumer surplus, defined as the difference between what consumers must pay for a given level of service and what they would be willing to pay. In passenger transportation markets, consumer surplus is usually defined in the context of the full price of travel. The full price of travel includes both the money fare that a consumer must pay and the value of his or her time in transit (including both the scheduled time and any expected delays).

Interpretation of the full price of travel in the context of consumer surplus is straightforward. A consumer would not choose to purchase a transportation service unless it was worth more to him or her than the sum of the money price and the value of his or her time. Consumer surplus is the value of air transportation in excess of the full price of travel.

To illustrate the application of the full price of travel framework to the *OMP Phase I Airfield* and *Master Plan Phase I* projects, refer to **Exhibit I-1**. The horizontal axis shows the annual number of passengers accommodated at the airport, while the vertical axis reports the full price of travel, consisting of the money fare and the value of time. In any given year, in the Base Case, where no project is undertaken, there is an equilibrium defined by Q_1 passengers and FPT_1 (the full price of travel). This occurs at the intersection of the demand curve (showing the total number of passengers accommodated at different levels of prices) and the cap on operations at the airport.[3]

Exhibit I-1

Illustration of Equal Delay in Base Case and Scenario Cases



Source: GRA, Inc.
Prepared by: Ricondo & Associates, Inc.

[3] The cap at O'Hare is on the number of aircraft operations during the day, which can then be translated into passenger counts.

In the *OMP Phase I Airfield* and *Master Plan Phase I* Scenario Cases, additional passengers are accommodated, and the average price paid must fall, so that Q_2 passengers and FPT_2 (full price of travel) is the new equilibrium. In *OMP Phase I Airfield* and *Master Plan Phase I* Scenario Cases (except in the first few years after the completion of construction), the expected delay for passengers would be identical. There would be small variations in unimpeded travel time. However, the value of time for each of the cases would be approximately equal. As a consequence, the reduction in the full price of travel would be largely attributable to a reduction in the money fare. Therefore, in order to increase passenger demand for travel at the airport, money fares would have to decrease. This is consistent with standard microeconomic principles.

The benefits of the *OMP Phase I Airfield* and *Master Plan Phase I* Scenario Cases can be measured in Exhibit I-1. In the Base Case, consumer surplus, defined as the area below the demand curve but above FPT_1 would be the triangle (FPT, FPT_1a). In the Scenario Cases, where the full price of travel is reduced, the benefits would be defined by (FPT, FPT_2b).[4] The difference between the Base Case consumer surplus and the Scenario Cases consumer surplus is the net benefit of the project, defined by the polygon ($FPT_1\ FPT_2ba$).

Interpretation of the net benefit is straightforward. Existing consumers at O'Hare would benefit from the reduction in the full price of travel resulting from the proposed projects. Most of this reduction in the full price of travel would be due to the reduction in money fare, for the reasons discussed above. The benefit to existing consumers is defined as the rectangle ($FPT_1\ FPT_2ca$). Additional consumers accommodated as a result of the expansion would also benefit, and their benefits are defined by the triangle (*abc)*.

It is important to note that Exhibit I-1 represents a "snapshot" for computing benefits in each year of the analysis. For each year, the change in consumer surplus (the difference between Base Case and proposed projects benefits) would be computed. The benefit stream would then be discounted to 2001, the base year for the analysis, which is consistent with the evaluation in the LOI request, the OMP EIS and the Airport Master Plan.

In this BCA, the analysis is conducted at the aggregate level. This facilitates the use of the TAF forecast and *Total Airspace and Airport Modeler* (TAAM) simulation results reported elsewhere in this document and used in other evaluations of the *OMP Phase I Airfield* and *Master Plan Phase I* projects, including the EIS. Specifically, to facilitate the analysis the following information was collected:

- Forecasts for passengers accommodated for the period 2007 through 2027
- The unimpeded travel times for both the Base Case and Scenario Cases
- Expected delays in both the base and Scenario Cases
- The average segment money fare at O'Hare
- The value of passenger time as reported by the FAA
- A range of elasticities to define the demand curve

[4] As explained in Appendix C, it has been assumed to the extent there is producer surplus in the Base Case, carriers would seek to preserve it in the *OMP Phase I Airfield* case. Because carriers have influence over the approval of the *OMP Phase I Airfield* case, their expectation must be that they can preserve whatever producer surplus exists in the Base Case, otherwise they would not be in favor of the project.

To identify the demand curve in each year, the full price of travel for the Base Case is computed. This is defined as the money fare plus the value of unimpeded travel time and the value of expected delay time, given the projected number of operations at the airport. The full price of travel in the Base Case and the projected number of passengers defines point *a* in the graph.

Then, the projected number of passengers that would be accommodated in the Scenario Cases and the elasticity of demand as recommended by the *BCA Guidance* document are used to compute the full price of travel in the *OMP Phase I Airfield* and *Master Plan Phase I* project cases. The following equation, $FPT_2 = -FPT_1(1+x)/(1-x)$ where $x = E_D\ (Q_1+Q_2)/Q_2-Q_1)$, and E_D is the arc elasticity of demand, and Q_1 and Q_2 are Base Case and proposed projects passengers, is used.[5]

With the estimate for the full price of travel in the Scenario Cases and the projected number of passengers that would be accommodated in those cases, point *b* in the graph is also defined. In order to compute the net benefits of the project in each year, is assumed that the demand curve is linear. It is then possible to calculate the polygon $(FPT_1\ FPT_2ba)$.

As noted previously, the net benefits of *OMP Phase I Airfield* and *Master Plan Phase I* cases would be computed for each year of the analysis, then discounted back to the year 2001. There are numerous ways to test the plausibility of the results including conducting sensitivity analyses as discussed in **Section V.2**. In addition to varying input variables in the sensitivity analyses, another important test for plausibility relates to the reduction in the money fare in the Scenario Cases over the entire analysis period. As noted previously, most of the reduction in the full price of travel in the *OMP Phase I Airfield* and *Master Plan Phase I* cases would be due to a reduction in the money fare. The money fare in the Scenario Cases can be easily computed from the information available by subtracting the value of time in transit and the value of passenger delay from FPT_2.

The methodology for computing net benefits in each year of the analysis is contained in **Exhibit I-2,** which is summarized in Appendix C of this document. Specific details relating to assumptions can be found in Sections II, IV and V.

[5] The arc elasticity is defined as $E_D = \dfrac{Q_2 - Q_1}{(Q_1+Q_2)/2} x \dfrac{FPT_1 + FPT_2}{(FPT_2 - FPT_1)/2}$. The *FPT* equation in the text is derived by solving this formula for FPT_2.

Exhibit I-2

Estimating Consumer Benefits Due to Infrastructure Expansion at a Congested Airport

	1	2	3	4	5	6	7	8	9	10	11	12
	Average Travel Time per Operation (minutes)	Value of Time per Minute	Base Case Value of Travel Time	Average Segment Money Fare	Base Case Full Price of Travel	Base Case Total Passengers (millions)	Scenario Total Passengers (millions): TAF unconstrained	Scenario Full Price of Travel	Benefits to Existing Passengers ($ mil)	Benefits to Incremental Pax ($ mil)	Total Benefits ($ Mil)	PV of Total Benefits @ 7%
Source	Simulation Studies	FAA Critical Values	(1) x (2)	DB1a Database	(3) + (4)	TAF Constrained	Unconstrained TAF [1]	see footnote [2]	((5)-(8))*(6)	0.5*((5)-(8))*((7)-(6))	(9)+ (10)	PV in Year 20XX
Year 1												
2												
3												
-												
-												
20												

1. The unconstrained TAF would be used up to the point where congestion reaches levels beyond which airlines are unwilling to schedule added flights
2. Col 8: -Col (5) *(1+x)/(1-x) where x = elasticity of demand * (col 7 + col 6)/(col 7 - col 6)
   Recommended values for elasticity of demand for these analyses can be found in the Guidance document on page C.2.

Comments:

1/ Average Travel Time per Operation Source: OMP Base Case TAAM simulation results - average of arrivals and departures including delay.

2/ Value of Time per Minute Source: Treatment of Passenger Time in Economic Analysis, FAA-APO-03-1, dated March 2003

4/ Average Segment Money Fare Source: Database Products, Inc. 2004 Calendar Year

6/ Base Case Total Passengers Sources: FAA TAF, U.S. DOT, Leigh Fisher Associates. Forecast: Constrained – No Project

7/ Scenario Total Passengers Sources: FAA TAF, U.S. DOT, Leigh Fisher Associates. Forecast: Constrained – Phase I Project

Source: GRA, Inc.
Prepared by: Ricondo & Associates, Inc.

For the purposes of this BCA, the benefit stream was calculated solely using benefits obtained from consumer surplus. As previously mentioned, two benefits can be obtained from consumer surplus calculations: a reduction in total travel time and a reduction in money fare. Other benefits of the *OMP Phase I Airfield* and *Master Plan Phase I,* including greater schedule predictability, ability to accommodate larger aircraft, and safety improvements are not considered at this time. In addition, those system benefits beyond O'Hare are not accounted for in this analysis. While this approach underestimates the overall benefits of the project, these benefits are not needed to demonstrate the program's justification.

A fully populated spreadsheet, with comments regarding mathematical steps, as used to develop the benefit stream for the Net Present Value (NPV) calculation is contained in **Appendix C**. This appendix also includes the document provided to the City by the FAA.

1.2 Benefit-Cost Comparison

The FAA's *BCA Guidance* requires an airport sponsor to perform the following activities in the preparation of a BCA:

- *Compare Benefits and Costs*: Most airport investments require resources at the outset of a project in return for an annual flow of benefits over the long-term future. Because the costs are incurred up front, and the benefits are returned over a longer time period, an analysis recognizing the time value of money must be conducted to appropriately compare the benefits and costs of alternatives to inform ultimate selection of the preferred alternative for development. In the BCA, discounted benefits and costs are used to accurately compare project scenarios by their NPVs and BCRs. Section V presents the comparison of benefits and costs. Detailed tables for these calculations can be found in Appendix A.

- *Conduct Sensitivity Analyses:* Sensitivity analyses are conducted to assess the ability of the project to meet the BCA requirements under alternative assumptions regarding future demand and economic values. This analysis is included as part of Section V, and detailed tables for these sensitivity analyses can be found in Appendix A.
- *Make Recommendation:* Finally, a BCA must state whether a project should be pursued based on the quantified benefits and costs, non-quantified benefits and costs, and sensitivity analyses.

2. Aviation Activity Forecasts

As previously discussed, the 2002 TAF served as the basis for the EIS analysis. The 2002 TAF, which presents aircraft operations and enplaned passengers by user category at the Airport through the year 2020, was prepared by FAA assuming the absence of any constraints to growth in activity at the Airport. Selected at the initiation of the EIS analysis, the 2002 TAF remains the basis for EIS analysis even though subsequent TAFs were published in 2003 and 2004. To maintain consistency with the EIS, the 2002 TAF is the primary unconstrained forecast used in this BCA.

Table II-1 presents the 2002 TAF of operations and enplaned passengers converted from federal fiscal years, which end September 30, to calendar years, and extrapolated through the evaluation period using linear extrapolation. As shown, the 2002 TAF forecasts grow to approximately 1.2 million operations and 50.4 million enplaned passengers in 2018, the last year of the EIS analysis.

Since initiation of the EIS analysis, the FAA has published a 2003 TAF and 2004 TAF, as shown on **Exhibits II-1** and **II-2**. Both the 2003 and 2004 TAFs contain operations and enplaned passenger forecasts greater than those in the 2002 TAF. As previously mentioned, the 2002 TAF is used in this BCA to maintain consistency with the EIS analysis.

In addition to the unconstrained forecast represented by the 2002 TAF, the FAA, as part of the EIS analysis, developed a constrained forecast to represent the potential activity at the Airport if no action is undertaken to improve Airport capacity. This constrained forecast was developed based on simulation modeling efforts to reflect the assumption that growth in aircraft operations will cease once delays exceed the level the airlines and FAA consider "acceptable." The EIS analysis period extends until 2018; however, the constrained forecast extends through 2028. Data for forecast years after 2018 were obtained by extrapolating values at gradually decreasing annual growth rates. This forecast is used in the benefit calculation and is the source of values for "Base Case Total Passengers."

An alternate constrained forecast is used for the *OMP Phase I Airfield* and *Master Plan Phase I* scenarios. This forecast also extends through 2028. Forecast values are identical to the 2002 TAF until 2016, after which time values are extrapolated using gradually decreasing annual growth rates. In both constrained forecasts passenger enplanements are expected to grow due to increased enplaned passengers per operation and an increase in originating passengers. **Table II-2** and **Table II-3** present the forecasts for enplanements used in the calculation of benefits from consumer surplus.

Table II-1

Unconstrained Forecast – Total Operations and Enplanements

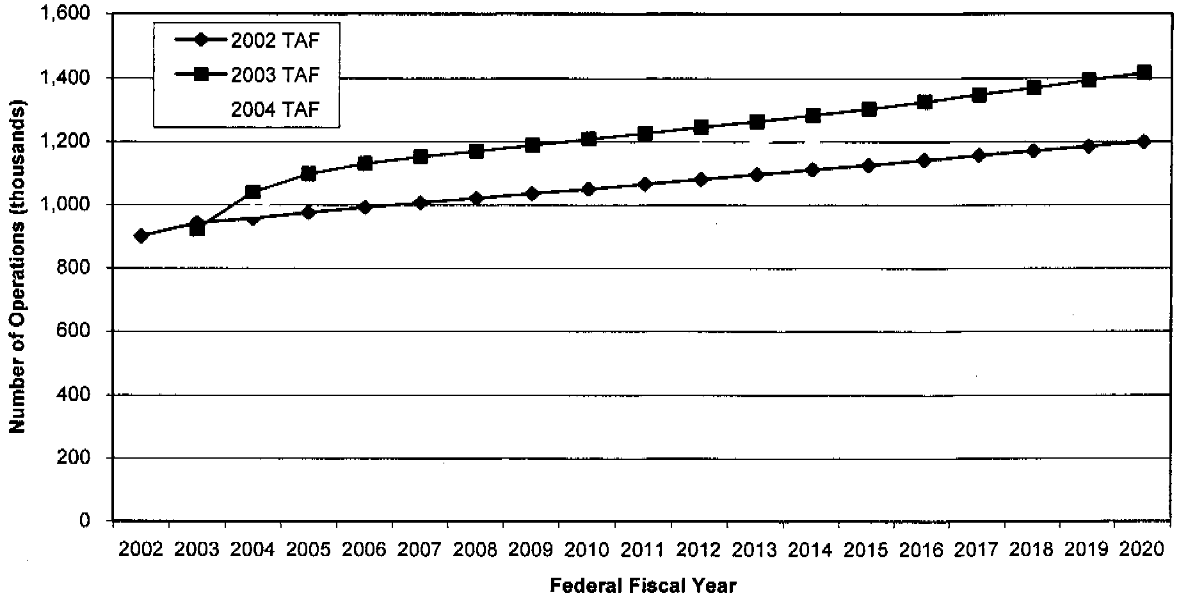
Calendar Year	Total Operations (2002 TAF)	Total Passenger Enplanements	
		2002 TAF	Extrapolation[1]
2002	922,787	31,710,512	
2003	960,500	32,609,000	
2004	976,544	33,633,730	
2005	992,855	34,696,477	
2010	1,072,706	40,280,622	
2015	1,149,402	46,367,491	
2018	1,194,000	50,372,000	
2020			52,224,100
2025			58,060,253
2030			63,896,405
2032			66,230,866

1/ Linear extrapolation based on calendar year projections.

Source: Forecast – FAA; Extrapolation – Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Exhibit II-1

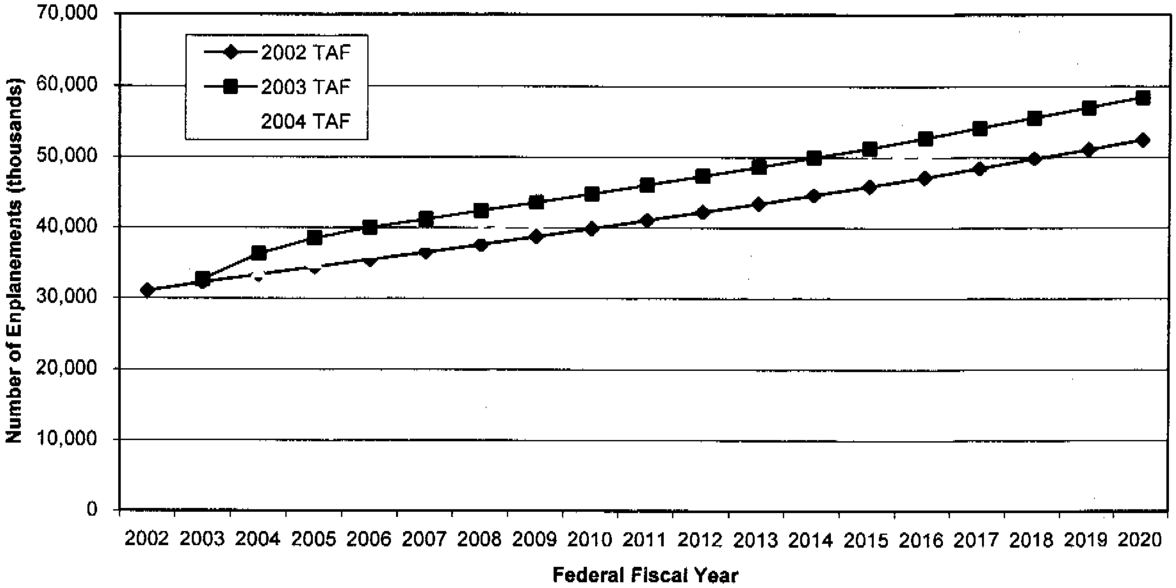
FAA Terminal Area Forecast Comparisons for O'Hare International Airport – Total Operations



Source: FAA
Prepared by: Ricondo & Associates, Inc.

Exhibit II-2

FAA Terminal Area Forecast Comparisons for O'Hare International Airport – Enplaned Passengers



Source: FAA
Prepared by: Ricondo & Associates, Inc.

Table II-2

Constrained Forecast – Base Case – Total Enplanements

	Total Passenger Enplanements	
Calendar Year	2002 TAF	Constrained
2002	31,710,512	
2003	32,609,000	
2004	33,633,730	
2005	34,696,477	
2006	35,798,962	
2007		36,219,500
2008		36,957,132
2009		37,717,500
2010		38,481,562
2011		39,267,508
2012		40,076,189
2013		40,908,500
2014		41,680,693
2015		42,472,622
2016		43,284,845
2017		44,117,940
2018		44,972,500
2019		45,692,000
2020		46,423,000
2021		47,166,000
2022		47,921,000
2023		48,688,000
2024		49,321,000
2025		49,962,000
2026		50,612,000
2027		51,270,000
2028		51,937,000

Source: FAA
Prepared by: Ricondo & Associates, Inc.

Table II-3

Constrained Forecast – OMP Phase I Airfield and Master Plan Phase I – Total Enplanements

	Total Passenger Enplanements	
Calendar Year	2002 TAF	Constrained
2002	31,710,512	
2003	32,609,000	
2004	33,633,730	
2005	34,696,477	
2006	35,798,962	
2007	36,943,000	
2008	38,027,251	
2009	39,149,000	
2010	40,280,622	
2011	41,450,619	
2012	42,660,538	
2013	43,912,000	
2014	45,119,418	
2015	46,367,491	
2016	47,181,000	
2017		48,110,000
2018		49,062,000
2019		49,994,000
2020		50,944,000
2021		51,810,000
2022		52,691,000
2023		53,587,000
2024		54,498,000
2025		55,315,000
2026		56,145,000
2027		56,987,000
2028		57,842,000

Source: FAA
Prepared by: Ricondo & Associates, Inc.

3. Project Costs

To provide the basis for the BCA and NPV calculations, costs associated with the project must be quantified to the extent possible. Quantifiable costs to be considered should consist of capital investment and incremental O&M costs. Only those costs that are attributable to a project being undertaken are to be considered. In other words, costs that would be incurred regardless of whether or not a project is undertaken should not be considered. Appendix B of this document provides information on the cost estimates utilized in this analysis, as well as the FAA's review of those cost estimates.

In addition to capital investment costs, estimated incremental O&M costs are included for the evaluation period. Incremental O&M costs for additional runway pavement were estimated at the unit rate for budgeted 2004 O&M expenses for the existing runways adjusted to 2001 dollars using the Gross Domestic Product (GDP) Implicit Price Deflator. Note, the O&M costs for the *Master Plan Phase I* scenario were over-stated in the February 2005 BCA. The correct O&M costs are used here. Making this adjustment to the February 2005 analysis would increase the associated benefits relative to costs. In addition, the February 2005 analysis utilized incorrect cash flows for Taxiway M; these cash flows have been corrected in this document and are reflected in Appendix B.

4. Project Benefits

The *BCA Guidance* suggests that consumer surplus is an appropriate measure of benefits in projects where an investment for current users of the airport will allow the airport to serve a greater portion of the unconstrained demand. The FAA's EIS proves that the proposed projects provide for significant increases in capacity; thus, making it reasonable to assume that a greater portion of the unconstrained demand will be served. The primary benefits obtained from the OMP will be in the form of lower total travel costs (travel time and money fare) and additional service.

4.1 Simulation Modeling

In the analyses undertaken as part of OMP planning and the EIS, operational delay and travel times were assessed for the Base Case, *OMP Phase I Airfield*, and the OMP Total Airfield. These assessments were undertaken using the TAAM, developed by Preston Aviation Solutions, a Boeing Company. TAAM is a fast-time gate-to-gate simulator of airport and airspace operations that facilitates decision-making, planning, and analysis. TAAM has been used in the United States for airfield and airspace assessments by the FAA, the National Airspace Redesign team, American Airlines, Continental Airlines, Delta Air Lines, and Boeing Air Traffic Management, among others. The FAA and its EIS consultant, known as the third party contractor (TPC), have been actively involved in the TAAM simulation analysis of the OMP. As documented in the EIS:

> "An unprecedented series of TAAM simulation analyses were conducted by the City of Chicago's Consultant Team (CCT) with direction, oversight, review and approval by the FAA and the TPC. The FAA and TPC participated in an intensive, nine-month review process during the simulation effort. The objective of this process was to ensure that TAAM input assumptions, modeling methodologies, and output data conformed to the industry best practices in modeling and accurately reflected air traffic control rules and procedures. In total, FAA invested over 2,000 hours reviewing assumptions, draft results, animations, and final results. The FAA review was conducted by an Air Traffic Work Group, which consisted of FAA Management and National Air Traffic Controller Association (NATCA) representatives from O'Hare Tower, the Chicago Terminal Radar Approach Control Facility (TRACON), and the Chicago Center (ZAU); FAA Airports Division; and the FAA's TPC." [6]

The simulation modeling showed that delays increase exponentially under the Base Case as demand approaches capacity. Theoretically, delays can continue to increase to unrealistically high levels as demand exceeds capacity for more and more hours of the day. However, these excessively high

[6] Source: FAA, *O'Hare Modernization Final Environmental Impact Statement & Section 4(f) and Section 6(f) & General Conformity Determination*, July 2005.

levels of delay may not be experienced, as the airlines and passengers may change their behavior to avoid these delays. In response to increasing delays, airlines might increase average aircraft size to accommodate forecast demand, shift connecting passenger traffic through other hub airports.

The FAA in its *BCA Guidance* recognizes the limitations on delay growth, and suggests the need to modify demand growth when delays exceed 15 minutes per operation and that demand should be capped at approximately 20 minutes of delay per operation. Consistent with the *BCA Guidance*, the FAA developed constrained activity forecasts in the EIS for the Airport to reflect the level of aircraft operations at which FAA believes further growth in aircraft activity would cease due to delays reaching "unacceptable" levels. As indicated in the EIS, the constrained forecasts developed by FAA result in maximum average aircraft delays at the Airport of approximately 17 minutes per aircraft, which is lower than the 20 minutes per aircraft threshold outlined in the *BCA Guidance*.

4.2 Simulation Results

As discussed earlier, simulation modeling using TAAM was performed to provide quantitative information on the performance of the Base Case and the Scenario Cases projects. The simulations used in this analysis are those originally prepared for the FAA EIS analysis. The methodologies and assumptions used in the simulation modeling have been documented in numerous data packages developed and published by the FAA in support of the EIS process. **Table IV-1** contains a summary of travel times for the Base Case and *OMP Phase I Airfield* and *Master Plan Phase I* Scenario Cases.

5. Benefit - Cost Comparison

The comparison of benefits and costs involves the calculation of NPVs and BCRs based on recognition of the time value of money in discounting the benefits and costs. Additionally, travel time savings must be converted into monetary values based on appropriate assumptions regarding the value of passenger time.

The analyses performed in this section provide the benefit-cost comparison for the *OMP Phase I Airfield* Projects. The following points outline relevant assumptions associated with the quantification of these benefits and **Table V-1** summarizes the assumptions.

- *Base Year.* Project benefits were evaluated using 2001 as the base year because OMP cost estimates are in 2001 dollars in the LOI request, OMP EIS, and Airport Master Plan. Project benefits and costs are stated in 2001 dollars in the year of accrual/expenditure, and to calculate present value, benefits and costs are discounted using a 7.0 percent discount rate, in accordance with the *BCA Guidance*.
- *Average Travel Time.* The average travel time per operation was obtained from TAAM simulations performed for the OMP. The travel time considered for this BCA is the Base Case scenario. It is an average of the arrival and departure travel times and includes minutes of travel delay.

Table IV-1

Summary of Travel Times from TAAM Simulations

Year	Base Case No Build	Scenario Cases	Difference in Travel Time[1]
2003	137.7	140.5	2.8
2004	139.8	141.5	1.7
2005	141.9	142.6	0.7
2006	144.0	144.7	0.7
2007	146.1	144.3	-1.8
2008	148.4	148.8	0.4
2009	150.7	146.1	-4.6
2010	152.8	146.7	-6.1
2011	154.8	147.4	-7.4
2012	156.9	148.5	-8.4
2013	158.9	155.0	-3.9
2014	159.5	156.7	-2.8
2015	160.1	158.6	-1.5
2016	160.8	158.6	-2.2
2017	161.4	158.6	-2.8
2018	162.0	158.6	-3.4
2019	162.0	158.6	-3.4
2020	162.0	158.6	-3.4
2021	162.0	158.6	-3.4
2022	162.0	158.6	-3.4
2023	162.0	158.6	-3.4
2024	162.0	158.6	-3.4
2025	162.0	158.6	-3.4
2026	162.0	158.6	-3.4
2027	162.0	158.6	-3.4
2028	162.0	158.6	-3.4

1/ Travel time is the average of arrival and departure time. All travel times are expressed in minutes. Difference in travel time calculated by subtracting Base Case from Scenario Case.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

- *Passenger Value of Time.* As set forth in the *BCA Guidance*, a blended rate accounting for the value of O'Hare's personal and business travelers' time may be used. As described in *the FAA APO Bulletin APO-03-1,* dated March 2003, the specified value of passenger travel time is $40.10 per hour for business travelers and $23.30 for personal travelers. Results of the In-Flight Air Survey in 1997 by Landrum & Brown indicated that business travel was the main purpose in 52.4 percent of trips while personal travel was the main purpose of 47.6 percent of trips. Based on this passenger distribution, the weighted average passenger cost for O'Hare is $32.10 per hour or $0.54 per minute.

- *Average Segment Money Fare.* The average segment money fare was compiled by Database Products, Inc. and obtained from U.S. DOT sources. The value was determined to be $220.05. Additional information about the average segment money fare can be found in **Appendix D**.

- *Elasticity of Demand.* As set forth in the *BCA Guidance*, values of total elasticity of demand for all travel distances are –0.8 for business travelers and –1.6 for non-business travelers. When the passenger distribution for ORD is applied to these values, the weighted value of the elasticity of demand is –1.18.

- *Salvage Value.* As set forth in the *BCA Guidance*, salvage value of the project may be considered. The salvage value of improvements at the end of the 20-year evaluation period is estimated to include only the value of the land acquired for the projects. For purposes of this analysis, it was assumed that the value of the land remains the same as on the purchase date, and the discounted value is included in the project benefits.
- *Sunk Costs.* As set forth in the *BCA Guidance*, sunk costs of the project should be excluded from the BCA. Through 2003, approximately $50.1 million has been spent on items considered to be sunk costs, and consequently, this amount was not included in the BCA.
- *Evaluation Period.* The evaluation period is the time period over which project benefits and costs are calculated. As recommended in the *BCA Guidance*, the evaluation period extends for 20 years after completion of construction.

Table V-1

Summary of BCA Data Sources and Assumptions

Input	Data Source	Assumptions
Average Travel Time (minutes)	TAAM Simulation Results from EIS	Average of Arrival and Departure times for operations
Passenger Value of Time ($/minute)	FAA-APO-03-1, Treatment of Values of Passenger Time in Economic Analysis, dated March 2003 • Value of Passenger Time: $23.30/hour (personal) $40.10/hour (business)	A weighted value of passenger time was used for calculations. Results from Landrum & Brown's 1997 In-Flight Air Survey indicated that the purpose of an air trip was business 52.4 percent of the time and personal 47.6 percent of the time. • Weighted Value of Passenger Time: $32.10/hour $00.54/minute
Average Segment Money Fare	U.S. DOT O&D passenger survey (10 percent ticket sample), Database Products, Inc.	Except under code-share agreements, the O&D survey does not include foreign flag carriers nor does it include data from air carriers flying aircraft with under 60 seats. The total revenue from passengers that have two stops in their itinerary is included in this fare calculation. Limitations to this data are addressed in a sensitivity analysis. • Average Segment Money Fare: $220.05
Base Case Total Passengers (millions)	Leigh Fisher Associates, FAA Terminal Area Forecast, and U.S. DOT data	An unconstrained forecast based on the 2002 TAF was used until 2007, after which time a "Constrained-Base Case" forecast was used.
Scenario Total Passengers (millions)	Leigh Fisher Associates, FAA Terminal Area Forecast, and U.S. DOT data.	An unconstrained forecast based on the 2002 TAF was used until 2016, after which time a "Constrained – OMP Phase I Project Airfield and Master Plan Phase I" forecast was used.
Present Value of Total Benefits	*BCA Guidance*	• Base Year: 2001 End Year: 2028 • Discount Rate for NPV: 7.0 % • Salvage Value: $51.4 million • Sunk Costs: $105.1 million
Scenario - Full Price of Travel (elasticity of demand)	*BCA Guidance* Table C.2: Total Elasticity of Demand • For all Travel Distances: -0.8 (business) -1.6 (personal)	The same business/personal percentages used to calculate the Value of Time were used to determine the Elasticity of Demand. • Elasticity of Demand: -1.18 (all travelers, all distances)

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

5.1 Project Analysis

Based on the information presented in Table V-1, and information on costs and travel time benefits presented in prior sections of this document, the BCR and NPV were derived for the *OMP Phase I Airfield* and *Master Plan Phase I* scenarios. These values are presented in **Table V-2**. As shown, the BCR is 6.3 for the *OMP Phase I Airfield* and 4.6 for the *Master Plan Phase I.* The NPVs are approximately $10.4 and $9.7 billion dollars, respectively. Supplemental information to illustrate the BCRs and NPVs for the *OMP Phase I Airfield* and *Master Plan Phase I* is contained in **Appendix A, Tables A-1** and **A-2.**

Table V-2

Benefit-Cost Ratios and Net Present Values (2001 dollars)

Scenario	Present Value Benefits (billions)	Present Value Costs (billions)	Net Present Value (billions)[1]	Benefit-Cost Ratio
OMP Phase I Airfield	$12.4	$1.9	$10.4	6.3
Master Plan Phase I	$12.4	$2.7	$ 9.7	4.6

1/ Total may not add due to rounding.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

It should be noted that implementation of the OMP is not expected to cause construction-related impacts. The City of Chicago, through its O'Hare Development Program, the Midway Terminal Program, and its annual airfield maintenance work, has displayed a long track record for success in implementing major construction projects. Weekly planning and programming sessions have been held (and will continue to be held through the duration of construction) with the FAA, airlines, and City of Chicago staff members and construction consultants in order to determine the most expedient methods for implementing the program without degradation of existing operational capability. These forums include, but are not limited to, the Phasing Operational Evaluation Team (POET) meetings and the Construction Operations Working Group (COWG) sessions. The efforts in these forums have thus far determined that is it possible to implement a large portion of the project landside; thus, allowing the construction activity to occur "off-airport." To the extent that construction activity must be performed on the active airport, significant attention has been (and will continue to be) paid to minimize disruptions to existing operations. These detailed planning sessions have proven successful in preparing for construction of the OMP. The City's methods have a long, proven track record of success. And the FAA will be involved through the planning, design, and construction of the OMP to ensure that operations at the Airport are not negatively impacted by construction activities.

This supplemental analysis provides for the quantification of benefits both with and without new terminal facilities. The airfield operations in both of these scenarios are the same. The existing terminal facilities at O'Hare have proven able to accommodate levels of passengers forecast to use the Airport in the Scenario Cases, suggesting that new terminal facilities are not necessary at such demand levels. However, this supplemental analysis illustrates sufficient benefits with respect to costs even with the Master Plan's Phase I terminal facilities included. Therefore, one can assume that the landside facilities will be available to process passengers in the Scenario Cases comparable to those processed in the Base Case.

5.2 Sensitivity Analyses

Due to the risks involved in infrastructure development and the number of assumptions regarding future conditions that occur in benefit-cost analyses, the analysis should be evaluated for its sensitivity to certain basic parameters to confirm its economic viability. For this BCA, the following sensitivity analyses were conducted for the *OMP Phase I Airfield* and the *Master Plan Phase I.* These assumptions are used only to demonstrate the continued economic justification for the *OMP Phase I Airfield* and the *Master Plan Phase I* under varying cost and schedule conditions and are not anticipated program changes.

5.2.1 Elasticity of Demand

To evaluate the range of elasticities of demand over which the project is cost beneficial, holding all other variables constant, different values for the elasticity of demand were entered as inputs until a cost-benefit ratio of approximately 1.0 was obtained. **Table V-3** describes the range of elasticity of demand for each scenario where the benefit-cost ratio is positive.

Table V-3

Range of Elasticity of Demand

Scenario	Original Elasticity Value	New Elasticity Value	New Benefit-Cost Ratio
OMP Phase I Airfield	-1.18	-7.65	1.0
Master Plan Phase I	-1.18	-5.62	1.0

Source: FAA, *Airport Benefit-Cost Analysis Guidance,* December 15, 1999; Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

The range over which the elasticity of demand values will still produce a positive benefit-cost ratio is quite large. The FAA has studied the elasticity of demand extensively, as noted in its *BCA Guidance;* the FAA's evidence suggests that elasticity levels are well within the range necessary to produce a positive benefit-cost ratio. A summary of the NPV calculations resulting from this sensitivity analysis can be found in **Table A-3** and **Table A-4** in Appendix A.

5.2.2 Future Enplanements

In order to evaluate the effects of changes in future demand, two sensitivity analyses involving future enplanements were performed. The first analysis determined the range of future demand over which the project would be cost beneficial, and the second analysis evaluated changes in NPV and BCR with the use of the 2004 TAF to predict future enplanements.

5.2.2.1 Range of Future Demand

To evaluate the range of future demand over which the project is cost beneficial, holding all other variables constant, the growth rate of passenger enplanements was reduced. This rate was reduced to the minimum value possible while still achieving a benefit-cost ratio of one. An annual average growth rate for each scenario was calculated for the forecast period (2002 through 2028). The average annual growth rate used in each scenario is presented below in **Table V-4**.

Table V-4

Average Annual Growth Rate for Future Demand

Scenario	Base Case Growth Rate[1/]	Project Growth Rate (Original)[1/]	Project Growth Rate (Sensitivity)[1]	New Benefit-Cost Ratio[1]
OMP Phase I Airfield	1.92 %	2.34 %	2.01 %	1.0
Master Plan Phase I	1.92 %	2.34 %	2.01 %	1.0

1/ Growth Rate refers to the annual average growth rate for the forecast period (2002 through 2028).

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

An annual average growth rate of 2.01 percent results in an 8.7 percent reduction in passengers in 2028 for the *Phase I Airfield* and an 8.6 percent reduction in passengers in 2028 for the *Master Plan Phase I.* Expressed as a number of passengers, this would be a 9.25 and a 9.18 million-passenger decrease, respectively. A summary of the NPV calculations resulting from this sensitivity analysis can be found in **Table A-5** and **Table A-6** in Appendix A.

5.2.2.2 2004 TAF

A sensitivity analysis was performed using the 2004 TAF as the basis for projecting passengers and operations at O'Hare under the *OMP Phase I Airfield* and the *Master Plan Phase I* project scenarios. Information regarding the development of this forecast is provided in **Appendix E**. Enplanements are forecast to grow at a lower rate than those found in the 2002 TAF. However, the decreased growth rate for enplanements only minimally impacts the BCR and NPV obtained for the *Phase I Airfield* and the *Master Plan Phase I.* **Table V-5** provides a summary of the results of this sensitivity analysis, and a summary of the NPV calculations resulting from this sensitivity analysis can be found in **Table A-7** and **Table A-8** of Appendix A.

Table V-5

Benefit-Cost Ratios and Net Present Values with 2004 TAF (2001 dollars)

Scenario	Present Value Benefits (billions)	Present Value Costs (billions)	Net Present Value (billions)[1]	Benefit-Cost Ratio
OMP Phase I Airfield	12.1	2.0	10.1	6.2
Master Plan Phase I	12.1	2.7	9.4	4.5

1/ Total may not add due to rounding.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

5.2.3 Value of Time

The influence of the value of time on the benefit stream was examined by assuming a passenger's value of time to be equal to zero. When the value of time is equal to zero, a positive BCR is still maintained for both scenarios. *OMP Phase I Airfield* has a BCR of 4.5, and *Master Plan Phase I* has a BCR of 3.3. A summary of the NPV calculations can be found in **Table A-9** and **Table A-10** in Appendix A.

5.2.4 Plausibility of the Money Fare

The plausibility of the analytical results reported above relates to the pattern of changes in the money fare in the *OMP Phase I Airfield* and *Master Plan Phase I* cases. As previously mentioned, the majority of the reduction in the full price of travel in the Scenario Cases is attributable to the reduction in the money fare.

The plausibility of the reduction in the money fare can be evaluated by comparing it to historical airline yield data. The Air Transport Association publishes data on airline yields, both in nominal and real dollars, since 1926. The data on real yields since 1978, the first year of airline deregulation, are reported in **Table V-6**. The annual rate of decline for domestic, international, and system-wide yields is reported at the bottom of the table; the average annual reduction in real yields for all three categories of air travel is 2.6 percent.

Table V-7 reports the money fare for each year of the Scenario Cases. Additionally, the table provides values for the scenario travel time and the full price of travel for the Scenario Cases. The full price of travel is decomposed into its two components, the money fare and the value of time. Based on the values contained in Table V-7, the money fare decreases at an average annual rate of 0.43 percent. The average annual reduction in money fare for the Scenario Cases is only a fraction of the average airline industry annual rate since deregulation. Thus, the decrease in money fare is plausible.

Table V-6

Annual Passenger Prices (Yield) for Scheduled Service on Domestic Airlines

	Real Yield (in 1978 cents)		
Year	Domestic	International	System
1978	8.49	7.49	8.29
1979	8.05	6.88	7.81
1980	9.09	6.96	8.70
1981	9.14	6.79	8.85
1982	8.12	6.47	7.95
1983	7.89	6.39	7.61
1984	8.03	5.89	7.60
1985	7.40	5.62	7.07
1986	6.59	5.73	6.50
1987	6.57	5.59	6.38
1988	6.78	5.73	6.55
1989	6.88	5.45	6.54
1990	6.70	5.40	6.37
1991	6.34	5.42	6.10
1992	5.97	5.37	5.81
1993	6.20	5.09	5.89
1994	5.77	4.92	5.54
1995	5.78	4.76	5.51
1996	5.72	4.54	5.41
1997	5.68	4.45	5.35
1998	5.63	4.15	5.24
1999	5.46	3.94	5.06
2000	5.52	4.01	5.12
2001	4.88	3.72	4.57
2002	4.35	3.57	4.15
2003	4.36	3.59	4.17
2004	4.16	3.66	4.04
Average Rate of Yearly Decrease	-2.6%	-2.6%	-2.6%

Source: The Air Transport Association of America, Inc. 1995-2005, http://www.airlines.org/econ/print.aspx?nid=1035
Prepared by: Ricondo & Associates, Inc.